Special Semester on Multiscale Simulation and Analysis in Energy and the Environment

Linz · Austria · October 3rd—December 16th, 2011

Technological advances have greatly improved our quality of life. However, they bring with them a huge surge in energy requirements which in turn puts at risk our entire bio-sphere. It is of paramount importance to predict these risks and to develop better solutions for the future. One of the central tasks is the accurate simulation of multiphase flow above and under ground. The key features that make it extremely hard to produce reliable predictions are the multiple time and length scales that arise, as well as the lack of and uncertainty in data. While there is a fairly long history of successful computation for such problems, their rigorous (numerical) analysis remains an urgent research problem.

The special semester aims to provide a stimulating environment for research on cutting edge problems in the analysis and computation of multiscale (direct and inverse) problems, and to stimulate collaboration between mathematicians, engineers, hydrologists, meteorologists and environmental scientists on problems in risk assessment and in the robust computation of atmospheric and subsurface flow and wave propagation.

Workshop 1
"Simulation of Flow in Porous Media and Applications in Waste Management and CO_2 Sequestration"
October 3rd—7th, 2011 · Organizers: P. Bastian, J. Kraus, R. Scheichl, M. F. Wheeler

Subsurface flow problems are inherently multiscale in space and time. Moreover, parameters of the models are difficult to access and often uncertain. The workshop will bring together mathematicians working in the analysis and computation of multiscale subsurface flows and practitioners whose interest is in the application of these core problems in areas such as deep geological disposal of radioactive waste or carbon capture and storage.

Invited Speakers include: S. Attinger, A. Cliffe, H. Dahle, M. Discacciati, Y. Efendiev, J. Erhel, A. Ern, R. Helmig, R. Kornhuber, P. Jenny, A. Michel, J. Nordbotten, P. Popov, M. Vohralik, M. Wheeler, B. Wohlmuth, I. Yavneh, I. Yotov

Workshop 2
"Large-scale Inverse Problems and Applications in the Earth Sciences"
October 24th—28th, 2011 · Organizers: M. Cullen, M. Freitag, S. Kindermann, H. Pikkarainen

Practical problems in the earth sciences have a very large number of degrees of freedom, however the measurements are limited and noisy. They are usually ill-posed, and occur in data assimilation and many other inverse problems in geophysics. The use of computer models to allow the observations to be exploited is essential. This workshop will examine the challenges that arise in doing this successfully.

Invited Speakers include: U. Ascher, G. Biros, M. Burger, O. Cirpka, M. Dashti, S. Gratton, E. Haber, B. Kaltenbacher, A. Lawless, H. Pikkarainen, R. Potthast, T. Payne, O. Talagrand, A. Weaver

Workshop 3
"Wave Propagation and Scattering, Inverse Problems and Applications in Energy and the Environment"
November 21st—25th, 2011 · Organizers: I. G. Graham, U. Langer, M. Melenk, M. Sini

The efficient computation of wave propagation and scattering arises in many applications in energy and the environment - e. g. wave propagation in heterogeneous media (climate modelling) and seismic inversion for subsurface imaging (oil exploration, earthquake prediction). In this workshop numerical mathematicians and practitioners will explore the latest research in these areas.

Invited Speakers include: H. Ammari, T. Betcke, S. Chandler-Wilde, P. Childs, B. Engquist, M. Gander, M. Grote, R. Hiptmair, I. Livshits, F. Nataf, T. Nguyen, R. Potthast, R. Ramlau, J. Schöberl, O. Steinbach, C. Stolk

Workshop 4
"Numerical Analysis of Multiscale Problems and Stochastic Modelling"
December 12th—16th, 2011 · Organizers: I. G. Graham, M. Melenk, R. Scheichl, J. Willems

This workshop focuses on effective computational tools for multiscale problems, uncertainty quantification, and adaptive modelling error control. Topics include homogenization, upscaling techniques and multiscale approximation, as well as Monte-Carlo, Quasi-Monte-Carlo, stochastic Galerkin/collocation methods, and adaptive techniques for high-dimensional problems.

Invited Speakers include: A. Abdulle, G. Allaire, A. Brandt, G. Dagan, B. Engquist, O. Ernst, V. Ha Hoang, R. Hilfer, R. Lazarov, O. Le Maitre, S. Margenov, H. Matthies, M. Sarkis, C. Schwab, A. Stuart, L. Zikatanov

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